SD11
.A1
A42
No. 234

BALSAM FIR

Balsam fir, a small to medium-sized coniferous tree, is one of the most symmetrical and beautiful species of our northern forests. The wood is light in weight and color, limber, soft, and low in decay resistance. It has good pulping properties and is used principally in the manufacture of pulp. Balsam fir is also widely used for interior knotty paneling, fish box construction, crates, cooperage, millwork, and similar products not requiring high structural strength.

LIBRARY
SEP 29 1970
ROCKY MOUNTAI ATION

U.S. Department of Agriculture
American Woods–FS–234

Forest Service
June 1970

Balsam Fir

(Abies balsamea)

By David L. Sonderman[1]

DISTRIBUTION

Extensive stands of balsam fir are found in the Boreal and northern forest regions of eastern North America (south of the Tundra), where the trees attain their greatest size and age and stands are denser. In Canada, the species ranges widely from Labrador, Newfoundland, Nova Scotia, New Brunswick, and Quebec, west through Ontario and the prairie provinces, northwest to Lesser Slave Lake and the Athabaska River in Alberta. In the United States, it ranges from Minnesota through Wisconsin, Michigan, northern Pennsylvania, New York, and New England. It also occurs locally in Virginia, West Virginia, northeastern Iowa, and southeastern Minnesota (fig. 1). It has a slightly more southerly range than its common associates—black spruce, white spruce, and tamarack.

Balsam fir develops best in the cool climate of southeastern Canada and northeastern United States on moderately deep sandy loam soils, well drained, yet abundantly moist. It grows more slowly in the Lake States, probably because precipitation is less.

Balsam fir grows from near sea level in Maine and southeastern Canada to timberline at about 5,600 feet in the northern Appalachians. Toward the western part of its range, from James Bay and Lake Superior to the Athabaska River in Alberta, stands become increasingly scattered and more restricted to stream valleys and north-facing slopes. Pure stands occur on low-lying moist flats and swamps; this species also mixes with black spruce, white spruce, and paper birch in the Boreal Region.

[1] Research forest products technologist, Northeastern Forest Experiment Station, Upper Darby, Pa.

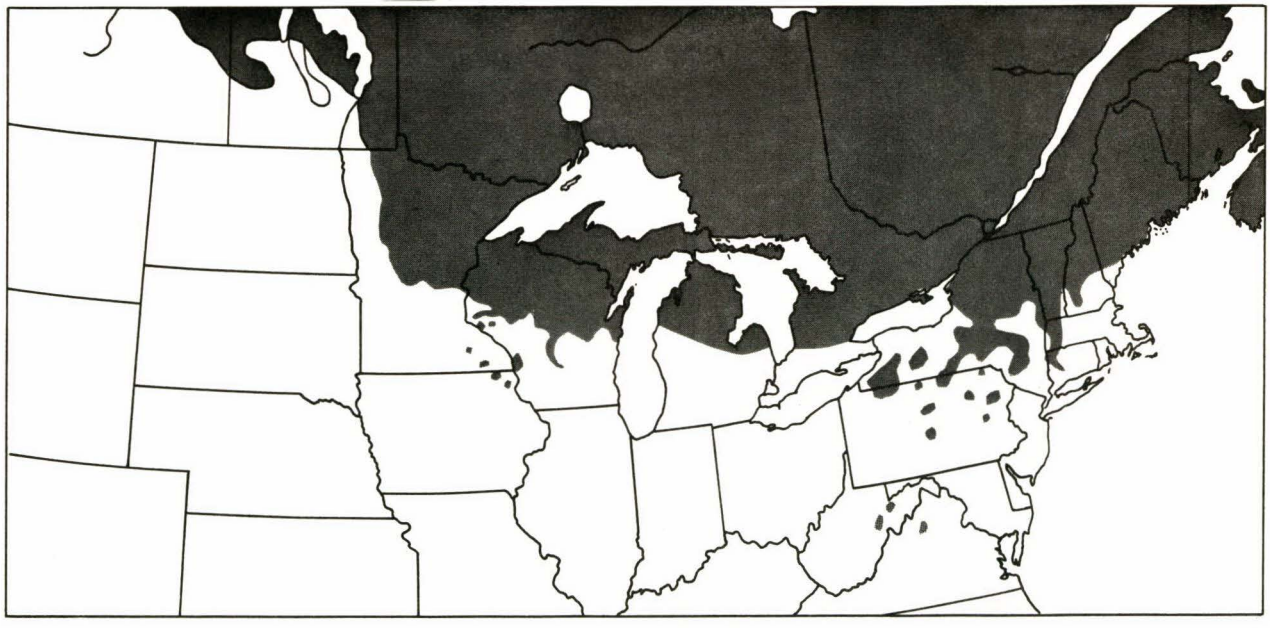


Figure 1.—Range of balsam fir.

DESCRIPTION AND GROWTH

A member of the pine family, balsam fir is one of the most symmetrical of northeastern coniferous species. Its narrow pyramidal crown terminates in a slender spirelike tip (see cover photo). On average sites, it reaches a height of 40 to 60 feet with a diameter at breast height (d.b.h.) of 12 to 18 inches. The maximum height reported is 75 feet; maximum d.b.h., 34 inches. Maximum age is about 200 years. Branches are generally in whorls of four or five. Needles, usually ¾ to 1½ inches long, are linear, flattened, shiny dark-green above, and silvery-banded below. Those on lower branches have a slight notch at the apex. On the upper branches, the needles are shorter, often sharp-pointed, and tend to crowd toward the upper surface of the twig.

The cones are 2 to 4 inches long, with short, round, irregularly-notched scales and pointed tips (fig. 2). Seeds are about ¼ inch long, with broad purplish-brown wings.

On young trees the bark is thin, with grayish patches, and smooth, except for numerous raised resin blisters. With age, the bark breaks up into small, reddish-brown, irregular scaly plates (fig. 3).

On wet sites, balsam fir root systems are shallow, making the trees extremely susceptible to windthrow and, in drought periods, to desiccation and fire damage.

Good seed crops occur every 2 to 4 years, with light crops at intervening years. Dominant trees produce the most seed. Seed fall begins in late August or early September and continues throughout the fall and winter, until early spring. With favorable seedbed conditions, most germination takes place from late May to early July.

COMMON NAMES

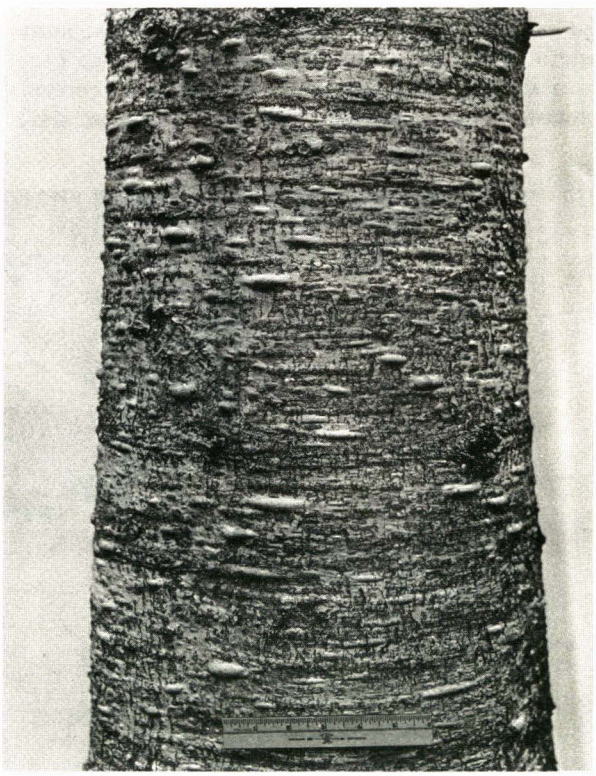
Balsam fir gets its name from the Latin word for balm. Some people have referred to the tree as the Balm-of-Gilead fir, but throughout its range it is commonly called balsam. Other common names are Canada balsam, eastern fir, and fir tree. It has also been called the blister fir because it has bark blisters that yield Canada balsam, a resin used for mounting microscope slides.

RELATED COMMERCIAL SPECIES

Balsam fir lumber is sometimes sold in mixture with spruce in the Lake States and the Northeast, and often competes with western true fir, western hemlock, and Douglas-fir in the Lake States markets.

F-462147

Figure 2.—Balsam fir cone.



F-325687

Figure 3.—Bark of mature balsam fir (age 55 years).

SUPPLY

The balsam fir-spruce type[2] occupies about 19.5 million acres of commercial forest land in the United States with the total fir volume estimated at more than 5 billion cubic feet. Over half of the total volume is in Maine. Minnesota, New Hampshire, and Michigan contained lesser quantities followed in decreasing order by Vermont, New York, Wisconsin, and Massachusetts.

The total volume of balsam fir sawtimber-size trees in the United States is estimated at 6 billion board feet; 75 percent of this total is located in the Northeast, the remainder is scattered throughout the Lake States. Pulpwood size trees (poletimber) account for slightly less than 4 billion cubic feet, about 72 percent of the total cubic volume.

In Canada, the total merchantable timber volume of balsam fir is estimated to be 76 million cubic feet, about equally distributed between sawtimber and poletimber trees.

[2] **National statistical reports no longer differentiate between balsam fir and spruce.**

PRODUCTION

Records of balsam fir lumber production in the United States, dating back to 1905 when 36 million board feet was produced, show a peak in 1914 of 125 million board feet. Thereafter, production declined to a low of 3 million board feet during the Depression. Since that time, annual balsam fir lumber production has been relatively low and figures have been combined with those for other minor species for statistical purposes. Current estimates place total production at 15 million board feet (fig. 4).

Maine, one of the leading States in balsam fir lumber production, now accounts for about 10 million board feet annually. In addition, an estimated 60 million board feet[3] of logs are exported from Maine—principally to Canada. Minnesota and Vermont usually rank next with an annual production of between 1 and 2 million board feet.

Canada, primarily Quebec and the Maritime provinces, produces much more balsam fir lumber than the United States: about 180 million board feet annually or around 3 percent of total Canadian lumber produc-

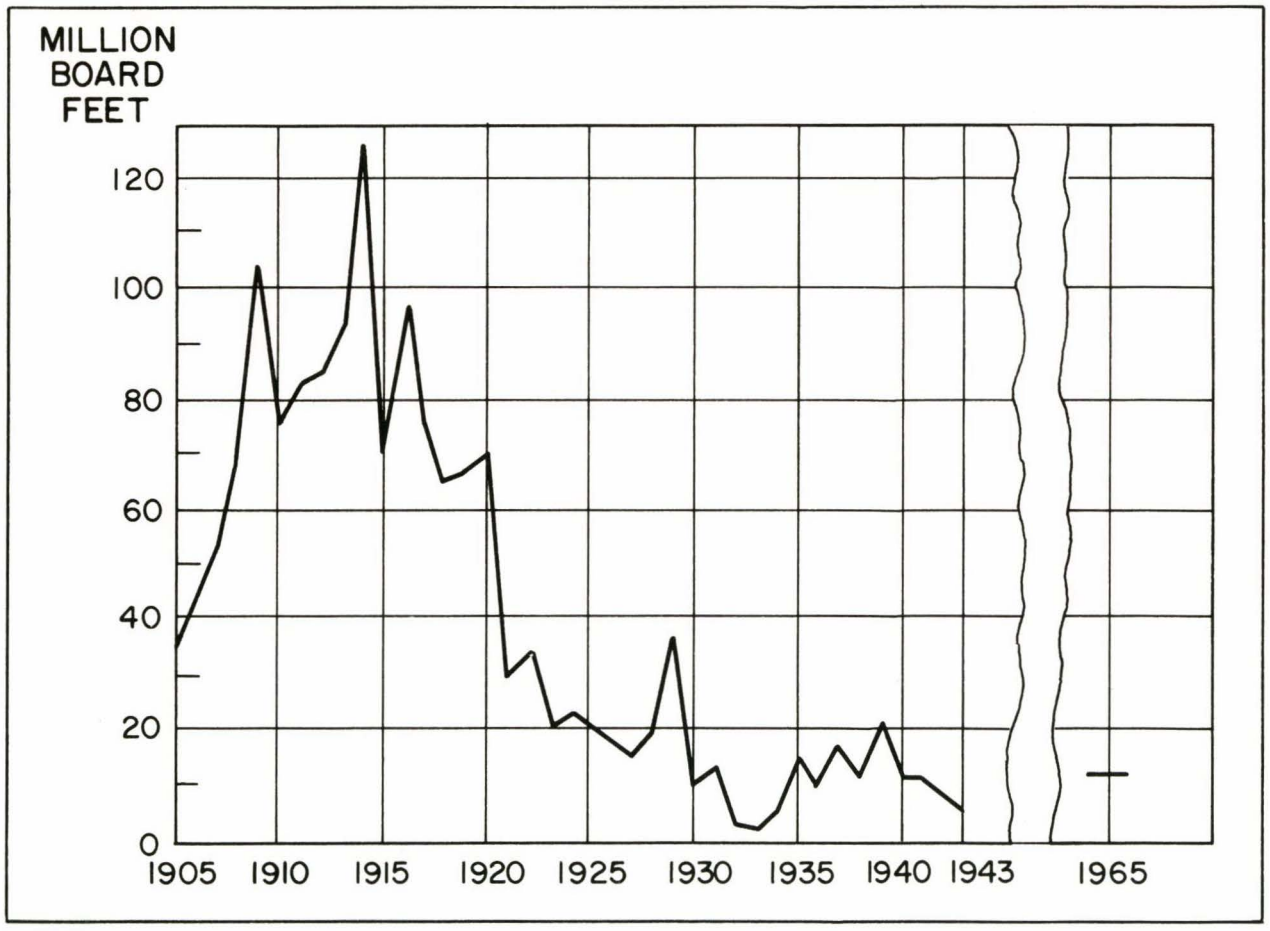


Figure 4.—Balsam fir lumber production (data unavailable for 1943 to 1964).

tion. The high production of balsam fir lumber in eastern Canada no doubt reflects the larger size, higher quality, and greater abundance of the species in that area.

In addition to lumber production, balsam fir pulpwood production has been a major forest industry in the United States for many years. In the early 1940's, about 470,000 cords of balsam fir pulpwood were produced annually; New York and New England produced somewhat more than half, and the Lake States produced the remainder. Lake States production figgures show that 330,000 cords of balsam fir pulpwood were produced in 1960, but only 230,000 cords in 1964—a 30 percent decrease in 4 years. Probably one reason for the decrease is the change in technology that permitted the use of hardwoods in various pulping processes.

Balsam fir pulpwood production figures for the Lake States (1964) are:

	Thousand cords
Michigan	84
Minnesota	89
Wisconsin	57
TOTAL	230

In the Northeast, pulpwood production has increased in recent years, with Maine leading all other Northeastern States in balsam fir-spruce[4] pulpwood production. It produced 1,444,000 cords in 1964.

Balsam fir-spruce pulpwood production figures for the Northeast (1964) are:

	Thousand cords
Maine	1,444
New Hampshire	95
New York	72
Vermont	105
TOTAL	1,716

Balsam fir accounts for over half the above figures for the Northeast. Total balsam fir pulpwood production in the United States is estimated to be more than one million cords.

Balsam fir has several insect enemies. The most important are the spruce budworm, *(Cristoneura fumifrana* (Clem.)), which causes heavy damage in mature stands by feeding on the needles, and the balsam wooly aphid, *Chermes* (Adelges) *piceae* (Ratz), which kills or deforms the tree by salivary injections.

Several serious decay-causing fungi are common in balsam fir stands. Butt rot, often entering the tree through roots and basal wounds, weakens it and makes it susceptible to windthrow, but does not greatly reduce sound timber volume. More serious is the red rot, *Stereum sanguinolentum* (alb. and Schw.), which causes trunk and top rot. It enters through stubs and broken tops, and is responsible for 2 or 3 times the cull losses caused by butt rot. These rots may occur as early as the 40th year and increase rapidly with aging. Generally more than half of all balsam fir trees are infected by 70 years of age.

CHARACTERISTICS AND PROPERTIES

The sapwood of balsam fir is creamy white, has little odor and taste, and is composed of bands of light-colored springwood and darker bands of summerwood. The heartwood is gray to gray-brown. The sapwood and heartwood are very low in resistance to decay, so balsam fir is one of the least durable woods.

Balsam fir wood is soft, limber, light in weight, low in bending and compressive strength, and low in ability to resist shock. It shrinks only moderately in drying and is easy to season, but is low in nail-holding ability. Balsam fir has a density of 26.9 pounds per cubic foot at a moisture content of 15 percent.

PRINCIPAL USES

Balsam fir, a major pulp species throughout its commercial range, is pulped by all of the pulping processes. With the groundwood or mechanical processes, pitch problems have caused some difficulty. Today balsam fir is extensively pulped by the sulfate and other semichemical processes. Good fiber length (3—4mm) and quality, combined with past, present, and potential future abundance at reasonable costs, are its chief advantages. Because balsam fir is less dense, it compares poorly with other pulpwood species in the yield of pulp per cord. Despite the species' low yield per cord, the manufacture of paper pulp is the most important use of balsam fir today.

Because the lumber is light in weight and workable, it is widely used by local contractors in the northern United States for light frame construction. Lesser amounts are being used for interior knotty paneling and may occur mixed with northern white cedar for this use. Because the wood lacks taste and odor, balsam fir is used extensively in fish box construction in Canada and the northeastern United States. It is used for crates, cooperage, millwork, and similar products not requiring high structural strength.

Canada balsam, an oleoresin found in balsam fir bark blisters, is used as a medium for the permanent mounting of microscopic specimens and as a cement for various parts of optical systems. As an optical cement, Canada balsam has a refractive index which, like that of ordinary glass, results in a minimum dispersion of light.

[3] **Annual Maine Timber Cut Summary for 1966. Unpublished data on file at Maine Forest Service, Augusta, Me.**

[4] **National statistical reports on pulpwood production and consumption in the Northeast no longer differentiate between balsam fir and spruce.**

Firs have long been traditional Christmas trees in both Europe and North America. Although balsam fir continues to be popular as a Christmas tree in the United States, it has lost its top position to Scotch pine. From 1948 to 1960, balsam fir dropped from first to third place in the national market; annual sales dropped from 6.4 million to 5.1 million trees. In the same period, the total purchases of Christmas trees (all species) increased from 21.5 million to 31.4 million annually. In 1964, balsam fir was still in third place with 4.1 million trees out of 33 million.

Because balsam fir is a major element in the Boreal forest composition, it plays an important part in the recreational use of the northern lands. The esthetic values of balsam fir, combined with other desirable qualities, assure it an important place among the forests of the future.

REFERENCES

American Forestry Association.
1955. These are the champs. Amer. Forests 61(9): 31–40.

Bakauzis, E. V., and Hansen, H. L.
1965. Balsam fir. Minneapolis: The University of Minnesota Press, 445 p., illus.

Carpenter, E. M., and Quinney, D. C.
1965. Balsam fir dimension lumber in selected Minnesota markets. USDA Forest Service, Lake States Forest Exp. Sta., Res. Paper LS–21, 13 p., illus.

Findel, E.W., Pfeifer, R.E., Horn, A.G., and Tubs, C.H.
1960. Michigan's forest resources. USDA Forest Service, Lake States Forest Exp. Sta., Sta. Paper 82, 46 p., illus.

Forest Products Laboratory.
1965. Wood Handbook. U.S. Dep. Agr., Agr. Handb. 72, 528 p., illus.

Forest Service.
1965. Silvics of forest trees of the United States. U.S. Dep. Agr., Handb. 271, 762 p., illus.

Forest Service.
1965. Timber trends in the United States. U.S. Dep. Agr., Forest Resource Rpt. 17, 235 p., illus.

Gill, Thomas G.
1965. Wood used in manufacturing industries. U.S. Dep. Agr., Statist. Bull. 353, 121 p., illus.

Hansen, H. L.
1964. Characteristics of Balsam fir. Amer. Christmas Tree Growers' Journal 8(4): 40–41, 52.

Harlow, W. M., and Harrar, E. S.
1958. Textbook of dendrology. Fourth ed., 561 p., illus.

Hart, A. C.
1959. Silvical characteristics of Balsam fir. USDA Forest Service, N.E. Forest Exp. Sta., Sta. Paper 122, 22 p., illus.

Horn, Arthur G.
1965. Pulpwood production in Lake States counties 1964. USDA Forest Service, Lake States Forest Exp. Sta., Resource Bull. LS–2, 19 p., illus.

Kingsley, N. P.
1967. Pulpwood production in the Northeast. USDA Forest Service, N.E. Forest Exp. Sta., Resource Bull. NE –5, 27 p., illus.

Morris, R. F.
1948. How old is a balsam tree? Forest Chron. 24: 106–110.

Panshin, A. J., de Zeeuw, Carl, and Brown, H. P.
1964. Textbook of wood technology, Vol. I–Structures, identification, uses, and properties of the commercial woods of the United States. Second ed., 643 p., illus.,

Stone, R. N.
1966. A third look at Minnesota's timber. USDA Forest Service, N.C. Forest Exp. Sta., Re-Source Bull. NC–1, 64 p., illus.

Stone, R. N., and Thorne, H. W.
1961. Wisconsin's forest resource. USDA Forest Service, Lake States Forest Exp. Sta., Sta. Paper 90, 52 p., illus.

ABOUT THE FOREST SERVICE

As our Nation grows, people expect and need more from their forests—more wood; more water, fish and wildlife; more recreation and natural beauty; more special forest products and forage. The Forest Service of the U.S. Department of Agriculture helps to fulfill these expectations and needs through three major activities:

- Conducting forest and range research at over 75 locations ranging from Puerto Rico to Alaska to Hawaii.
- Participating with all State forestry agencies in cooperative programs to protect, improve, and wisely use our Country's 395 million acres of State, local, and private forest lands.
- Managing and protecting the 187-million acre National Forest System.

The Forest Service does this by encouraging use of the new knowledge that research scientists develop; by setting an example in managing, under sustained yield, the National Forests and Grasslands for multiple use purposes; and by cooperating with all States and with private citizens in their efforts to achieve better management, protection, and use of forest resources.

Traditionally, Forest Service people have been active members of the communities and towns in which they live and work. They strive to secure for all, continuous benefits from the Country's forest resources.

For more than 60 years, the Forest Service has been serving the Nation as a leading natural resource conservation agency.

☆U.S. GOVERNMENT PRINTING OFFICE: 1970 O—382-901